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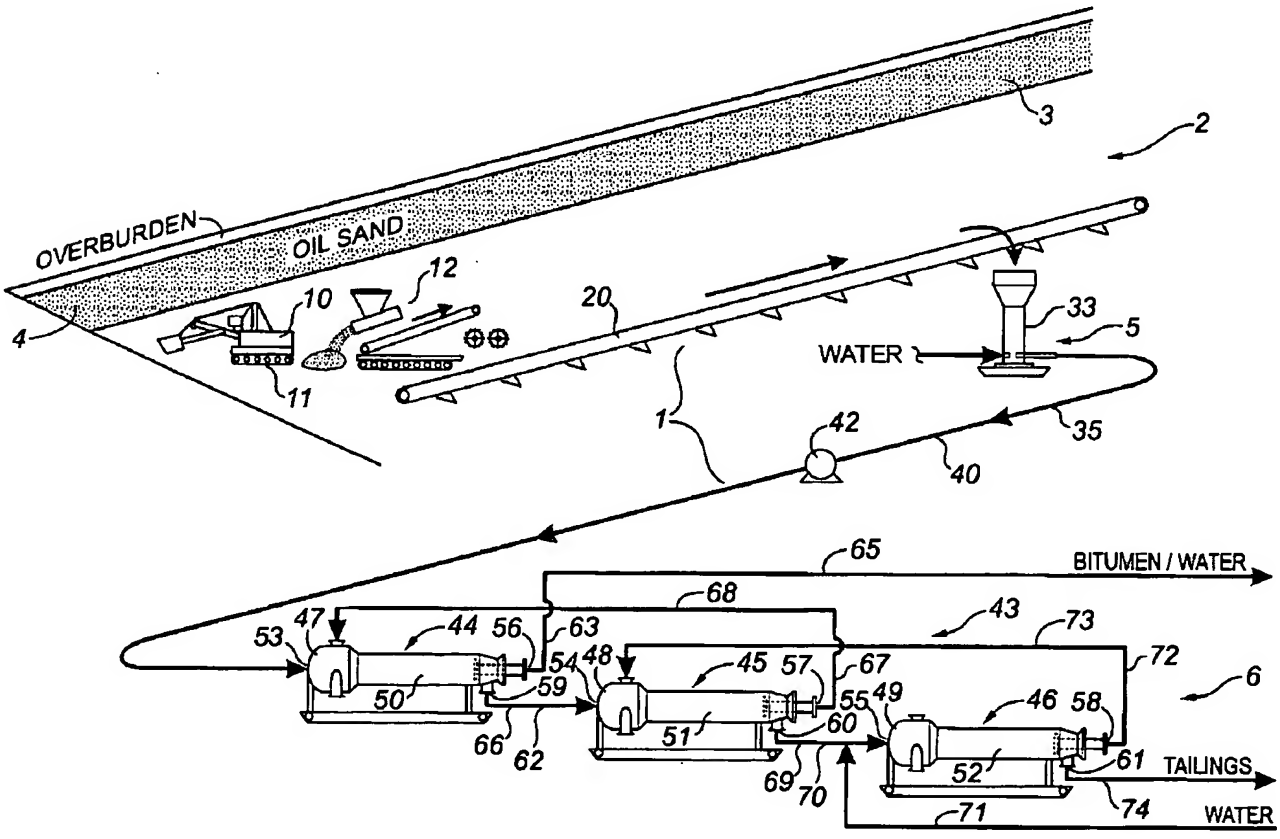

(57) Abrégé/Abstract:
A process line comprising a combination of mobile and relocatable equipment units is provided at an oil sand mine site. The process line may comprise: a mobile shovel; a mobile bin and double roll crusher; a relocatable conveyor belt extending along the mine face; a relocatable slurry preparation assembly, such as a secondary crusher and jet pump; a pipeline; and a relocatable

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(57) Abrégé(suite)/Abstract(continued):
desanding circuit of separators. The process line conducts the following steps: mining the oil sand; crushing it to conveyable size; conveying it to a slurry preparation location; further crushing it to slurrying size and mixing it with heated water to produce a pumpable, aerated oil sand slurry; transporting and conditioning the slurry in the pipeline; desanding it to produce a product comprising bitumen and water and tailings; depositing tailings in a retention facility; and removing the product from the mine site in a pipeline.

"AT THE MINE SITE OIL SANDS PROCESSING"

ABSTRACT OF THE DISCLOSURE

A process line comprising a combination of mobile and relocatable equipment units is provided at an oil sand mine site. The process line may comprise: a mobile shovel; a mobile bin and double roll crusher; a relocatable conveyor belt extending along the mine face; a relocatable slurry preparation assembly, such as a secondary crusher and jet pump; a pipeline; and a relocatable desanding circuit of separators. The process line conducts the following steps: mining the oil sand; crushing it to conveyable size; conveying it to a slurry preparation location; further crushing it to slurrying size and mixing it with heated water to produce a pumpable, aerated oil sand slurry; transporting and conditioning the slurry in the pipeline; desanding it to produce a product comprising bitumen and water and tailings; depositing tailings in a retention facility; and removing the product from the mine site in a pipeline.

"AT THE MINE SITE OIL SANDS PROCESSING"

FIELD OF THE INVENTION

The present invention relates to a system, located at a mine site, for mining oil sand, slurrying it and desanding the slurry to produce a pipelineable stream of bitumen, fines and water.

BACKGROUND OF THE INVENTION

Oil sand from the Fort McMurray region of Alberta has now been commercially surface mined and processed for about 40 years, to extract and recover the contained bitumen.

The initial technique used can broadly be described as follows:

- excavating oil sand;
- crushing the as-mined oil sand, which contains large lumps and rocks, in stages, to a size which can be slurried and pumped;
- mixing the crushed oil sand with heated water and, optionally, caustic or other process aids, to produce a slurry. In the course of mixing and subsequent pipelining, lumps are ablated, bitumen is liberated from the oil sand and is dispersed into the water phase, air bubbles are entrained and bitumen droplets coalesce and are aerated (the sum of these results is referred to as 'conditioning');
- temporarily retaining the conditioned slurry under quiescent conditions in a large gravity separation vessel (referred to as the 'PSV') – during this separation or flotation step, the sand settles and is removed as an underflow, together with some bitumen and water,

and the aerated bitumen, contaminated with water and solids, including fines, rises and is recovered as a froth;

- optionally, withdrawing watery middlings from the PSV and treating the middlings in induced air flotation cells to recover contained bitumen as a contaminated froth while rejecting water and solids as an underflow;
- processing the PSV underflow to recover contained bitumen as froth while rejecting water and solids (together with small amounts of contained residual bitumen) as an underflow;
- discarding the various water and solids underflows as tailings into retention areas; and
- combining and cleaning the froth streams in means such as centrifuges to remove residual water and solids and produce relatively clean bitumen ready for upgrading.

In selecting and developing the detailed steps, conditions and equipment units that embody this broadly described system, it needs to be appreciated that many factors have an influence in arriving at the final implementation. Some of these factors are:

- The oil sand is erosive and tacky and the throughput of oil sand is large. A typical circuit or process line, involving process steps and equipment units, might process 8000 tonnes of oil sand per hour. So the equipment used needs to facilitate processing this scale of throughput of erosive, tacky material;

- The oil sand contains clays that affect processing detrimentally and the composition of the oil sand varies on an on-going basis, particularly with respect to bitumen and clay contents. It is therefore desirable to provide a system that is amenable to oil sands blending;
- The system involves a line of sequential equipment units and steps. Therefore, periodic upsets along the processing line can create problems both upstream and downstream. It follows that surge capabilities and inventory supply along the line are therefore desirable, together with the feasibility of bypassing units if required;
- The mining operations can be remote from the gravity separation and cleaning process operations and this separation usually increases steadily as mining proceeds. So a system adapted to cope with on-going variation in separation is desirable;
- The bitumen constitutes only a small fraction of the oil sand. The main component is sand. The sand is, of course, without value and thus there is incentive to separate it out of the slurry at the first opportunity and deposit it as fill in the mine pit. So a system which is amenable to this end is desirable; and
- Of course it is desirable that the recovery of bitumen be maximized and the loss of bitumen with the tailings minimized.

In the early embodiments of these facilities, the as-mined oil sand was transported on belt conveyors from the mine sites to central processing plants. However, the conveyors, often stretching for miles, were expensive and difficult to operate. Later it was found feasible to crush and mix the oil

sand with heated water at the mine site and then pump the resulting slurry through a pipeline directly to a remote PSV. Today, this type of operation is being implemented as new mining areas are developed. At the applicants' facility, this scheme more specifically involves:

- advancing a mobile shovel along the mine face to excavate oil sand and load it into large trucks which haul the as-mined oil sand some distance to a double roll crusher;
- dumping the as-mined oil sand into a hopper feeding the double roll crusher, which crushes the oil sand to conveyable size (i.e. -24 inches);
- delivering the crushed ore to a surge pile using a belt conveyor;
- gravity feeding oil sand from the surge pile to another belt conveyor and delivering it to the top end of a mixer tower. The mixer tower incorporates a downwardly descending arrangement of a slurry mixer, a slurry screen and a pump box. In the course of moving down through the tower elements, the oil sand is mixed with heated water in the mixer to form the slurry and the slurry is then screened to remove oversize. The screened slurry is received in the pump box and the oversize is dumped on the ground for removal or is transferred to a secondary tower where similar operations are repeated on the oversize; and
- then pumping the slurry in the pump box through a pipeline to a PSV located at a processing plant remote from the mine site.

However, the trucks constitute a significant portion of material handling cost and the distance they must travel becomes greater as the mine face moves away from the mixer tower.

Thus there exists a need for a different combination of processing steps and equipment units, which eliminates or reduces reliance on trucks and which can better cope with the gradual advance of the mine face.

SUMMARY OF THE INVENTION

The phrase "mine site", as used herein, means an area of land presently undergoing strip mining to excavate oil sand and which has one or more mine faces and one or more tailings retention facilities, which may be dike-enclosed areas or mined-out pits.

The adjective 'mobile', as used herein, is intended to indicate that equipment is mounted on driven tracks or the like for on-going advancement over terrain.

The adjective 'relocatable', as used herein, is intended to indicate that equipment is of a transportable size and on skids or the like, or can be readily disassembled into transportable sections, whereby it is stationary when operating but it is feasible to periodically move it from location to location, perhaps every few months.

The term "unit", as used herein, is intended to mean a single piece of equipment or an assembly of pieces of equipment, which functions to perform one or more defined steps such as crushing and/or mixing.

In accordance with one embodiment of the invention, a process line comprising a combination of operatively connected mobile and relocatable equipment units is provided at a mine site. The process line functions to

excavate oil sand and produce a stream of pumpable, aerated, aqueous oil sand slurry. More particularly, the process line comprises:

- a mobile excavating means for advancing along a mine face and excavating oil sand;
- a mobile sizing means for advancing along behind the excavating means, receiving the oil sand and comminuting it to conveyable size;
- a relocatable first conveyor means, preferably extending along the mine face, for receiving the once comminuted oil sand from the sizing means and conveying it to a slurry preparation location;
- a relocatable slurry preparation means, at said location, for mixing the oil sand with heated water and producing a pumpable, aerated, aqueous oil sand slurry; and
- a first pipeline means for receiving the slurry and pumping and transporting it while simultaneously conditioning it, whereby said means produces a stream of slurry amenable for desanding and delivers it to a desanding location.

In one preferred feature of this embodiment of the process line, a lengthy first conveyor means, extending along the mine face, permits the slurry preparation means to remain stationary for a period of time, while coupling it for oil sand supply with the mobile and advancing excavating and sizing means.

In another feature of this embodiment, the slurry is moved through a pipeline, while on the mine site, to condition it in preparation for desanding.

In another aspect of the described embodiment, a process is provided comprising the steps of:

- excavating oil sand progressively along a mine face;
- comminuting the oil sand to conveyable size;
- conveying the comminuted oil sand along the mine face to a slurry preparation location on the mine site;
- mixing the oil sand with heated water at the slurry preparation location and producing a pumpable, aerated, aqueous oil sand slurry; and
- transporting the slurry through a pipeline from the slurry preparation location to a desanding location.

In an optional extension of the previously described process and process line, a relocatable desanding means is connected with the first pipeline means at the desanding location. The desanding means functions to receive the slurry and separate liquid and sand components of the slurry. It produces a desanded product, mainly consisting of bitumen, fines and water, and tailings, which mainly consists of sand, fines and water.

The desanding means preferably comprises a circuit of separators, arranged in series and operating countercurrently, wherein the underflow (or heavy fraction output) of one separator is fed to the next separator, the underflow of the last separator is tailings and the overflow (or lighter fraction output) of the first separator goes to a product pipeline, which transports it from the mine site, while the overflow of each following separator is recycled to the preceding separator.

It is a feature of the desanding circuit that subjecting separator underflow to secondary separation improves the probability of recovering contained bitumen.

The underflow of the last separator may be discarded into a dike-enclosed retention area or mined-out pit or otherwise processed as described below.

In a preferred embodiment, a plurality of such process lines are employed at the same mine site. As a consequence it is possible to transfer oil sand ore or slurry between process lines to cope with upsets or equipment repairs.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic showing the process line for excavating, conveying and preparing a pipelineable slurry;

Figure 2 is a schematic showing the process line at a mine site having mineable oil sand and employing the steps of: excavating oil sand; conveying it; mixing it with water to form a slurry; transporting and conditioning the slurry; and desanding it to produce desanded product and tailings;

Figure 3 is a schematic similar to Figure 2 but showing an inclined settler substituted for a cycloseparator in the desanding circuit;

Figure 4 is a schematic showing a plurality of process lines at a mine site, wherein in one process line a bucket wheel excavator is substituted for a shovel, and further showing a tailings retention facility and a thickener for concentrating fine solids from the tailings;

Figure 5 is a perspective view of a rotary digester, which may be used in the process line to form the slurry;

Figure 6 is a view similar to Figure 5, showing part of the drum wall broken away to display internal lifters;

Figure 7 is a side view of a cycloseparator, which may be used in the desanding circuit showing the internal section of the vortex finder in dotted lines; and

Figure 8 is a sectional side view showing an inclined settler.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A process line 1 in accordance with the invention comprises a series of operatively connected processing units located at a mine site 2. The mine site 2 is positioned on a body of mineable oil sand 3, such as exists in the Fort McMurray region of Alberta. The mine site 2 has one or more mine faces 4, a slurry preparation location 5, a desanding location 6 and a tailings retention facility 7. As the mine faces 4 advance, one or both of the locations 5,6 will periodically advance as well. As shown in Figure 4, a plurality of process lines 1 may be in use on the mine site 2.

In the preferred embodiment (as shown in Figures 1 and 2), each process line 1 comprises:

- A mobile mining shovel 10, which is mounted on driven tracks 11. The shovel 10 is positioned at the mine face 4 for excavating the oil sand 3. It is operative to advance along the mine face 4. Otherwise stated, the shovel 10 provides mobile

excavating means for advancing along the mine face 4 and excavating oil sand 3;

- A mobile sizing unit 12 which comprises a surge bin 13, an apron feeder 16, a double roll crusher 14, and a conveyor and belt wagon 15. The sizing unit 12 is mounted on one or more platforms 17, each supported on drive tracks 18.

In operation the shovel 10 dumps oil sand 3 into the surge bin 13. The apron feeder16 feeds oil sand 3 from the bin 13 to the crusher 14. The crusher 14 comminutes the excavated oil sand 3 to a size that is conveyable on a belt conveyor, for example to –24 inch. The feed conveyor 19 deposits the oil sand 3 onto the conveyor and belt wagon 15 which feeds the adjacent mine face conveyor belt 20.

In summary, the sizing unit 12 provides mobile sizing means for advancing along behind the excavating means, receiving excavated oil sand and comminuting it to conveyable size;

- An elongate, relocatable conveyor belt 20 which extends along the mine face 4. The conveyor belt 20 receives the oil sand 3 from the feed conveyor 19 and conveys it to a surge pile 21 located at the slurry preparation location 5.

In summary, a relocatable first conveyor means receives the oil sand 3 from the sizing means, conveys it to the slurry preparation location 5 and delivers it thereto;

- A relocatable slurry preparation unit 25 positioned at the slurry preparation location 5. The unit 25 comprises the surge pile 21, a feed conveyor 26, a hopper 27, a feed conveyor 29, a double roll crusher 30, a feed conveyor 31, a hopper 32, a jet pump 33 and a source 34 of heated water.

In operation, oil sand 3 is fed from the surge pile 21 by the feed conveyor 26 into the hopper 27 and fed by the conveyor 29 to the crusher 30. The sum of these actions is referred to collectively as utilizing the oil sand. The crusher 30 comminutes the oil sand to pumpable size, typically –4 inches. A conveyor 31 feeds the crushed oil sand 3 into the gravity feed hopper 32 of the jet pump 33. The hopper 32 dispenses the oil sand 3 into the jet pump 33, where it is entrained into a jet of motive heated water. A source 34 supplies the water to the jet pump 33. The jet pump 33 mixes the oil sand 3 and water, while entraining air, to produce a pumpable, aerated, aqueous oil sand slurry 35.

In summary, there is provided relocatable slurry preparation means, at the slurry preparation location 5, for utilizing the oil sand 3 delivered thereto, further comminuting it to pumpable size and mixing it with heated water to produce a pumpable, aerated, aqueous oil sand slurry 35;

- A slurry pipeline 40 which is connected with the outlet of the jet pump 33 and extends to the desanding location 41. The pipeline 40 may include one or more slurry pumps 42.

In the course of being pumped through the pipeline 40, the slurry stream 35 is mixed and conditioned.

In summary, there is provided a first pipeline means, connected with the slurry preparation means, for receiving the slurry 35, transporting it while simultaneously conditioning it, and delivering it to the desanding location 6 for desanding;

- A relocatable desanding circuit 43, which is positioned at the desanding location 6 and is connected with the downstream end of the slurry pipeline 40.

The desanding circuit 43 comprises a series of countercurrently operating separators. More particularly, the separators used are centrifugal cycloseparators 44, 45, 46, one of which is shown in Figure 7. The cycloseparators 44, 45, 46 are, respectively, generally cylindrical, hollow vessels 47,48, 49 having internal chambers 50, 51, 52, tangential inlets 53, 54, 55 at the upstream end and central vortex finder outlets 56, 57, 58 and peripheral outlets 59, 60, 61 at the downstream ends.

The slurry stream 35 is pumped from the pipeline 40 into the tangential inlet 53 of the first cycloseparator 44 (shown in Figure 2). The slurry spins as it advances longitudinally through the vessel chamber 50. The heavier fraction (mainly sand, fines

and some water and bitumen) concentrates outwardly and leaves the vessel chamber 50 as an underflow stream 62 through the peripheral outlet 59. The lighter fraction (mainly bitumen, fines and water) concentrates inwardly and leaves the vessel chamber 50 as a central overflow stream 63 through the vortex finder outlet 56. The first separator overflow stream 63 is fed as desanded product to a product pipeline 65 which transports it from the mine site 2 to a remote processing plant (not shown). The first separator underflow stream 62 is fed through outlet 59 and line 66 to the inlet 54 of the second separator 45. The same type of centrifugal separation occurs in the second separator chamber 51. The overflow stream 67 from the second separator chamber 51 is recycled through line 68 to the inlet 53 of the first cycloseparator 44. The underflow stream 69 from the second cycloseparator 45 is fed through the line 70 to the inlet 55 of the third cycloseparator 46. Water may also be added as required through line 71 to the inlet 55 of the third cycloseparator 46, as the underflow stream, 69 may need dilution. The overflow stream 72 from the third cycloseparator 46 is recycled through line 73 to the inlet 54 of the second cycloseparator 45. The underflow stream 74 from the third cycloseparator 46 is removed through the line 75 as tailings.

In summary, there is provided relocatable desanding means, at the desanding location and connected with the first

pipeline means, for receiving the slurry and separating liquid and sand components of the slurry to produce separate streams of desanded product and tailings;

- Means are provided for depositing the tailings at the retention facility 7 (see Figure 4). In the preferred embodiment, a mobile boom 80, carrying a cyclone 81 at its upper end, is positioned alongside the retention facility. The line 74 feeds the stream 74 of tailings to the cyclone 81, which separates the tailings components to produce an underflow stream 82, mainly comprising sand and some water, and an overflow stream 83, mainly comprising water and fine solids (clay). The underflow stream 82 is deposited on the beach 84 of the retention facility 7. The overflow stream 83 is conveyed through a line 85 to a thickener 86. The thickener 86 separates the cyclone overflow components to produce a paste-like underflow stream 87, which is deposited in the mined out pit, and a water stream 88 which may be recycled to the desanding circuit 43.

Variants

It is to be understood that applicants contemplate that a person skilled in the art may substitute units without significantly affecting the way in which the process line 1 works.

For example:

- A bucketwheel excavator 90, shown in Figure 4, may be substituted for the shovel 10;

- A rotary digester 91, shown in Figures 5, 6, may be substituted for the jet pump 33. The digester 91 is capable of processing larger lumps of oil sand and thus may not require a secondary crusher 30.

  The digester 91 is a rotatable drum 92 having internal lifters 93, drive means 94 and a trommel screen 95. The oil sand and water are fed into a feed box 96 and are tumbled within the drum 92 to mix them and condition the produced slurry. The screen 95 removes oversize and the screened slurry is pumped through pipeline 40 by pump 97; and

- an inclined plate separator 100, shown in Figure 8, may be substituted for a cycloseparator.

The slurry is fed into the bottom inlet 99 of the separator 100 from pipeline 40. The sand separates and drops along the internal plates 101 and is withdrawn through the outlet 102. The water, some bitumen and fine solids leave through the top outlet 103.

The scope of the invention is defined by the claims now following.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A process line for producing an oil sand slurry at a mine site having mineable oil sand, a mine face, a slurry preparation location and a desanding location, comprising:

mobile excavating means for advancing along the mine face and excavating oil sand;

mobile sizing means for advancing along behind the excavating means, receiving excavated oil sand and comminuting it to conveyable size;

relocatable first conveyor means for receiving the oil sand from the sizing means, conveying it to the slurry preparation location and delivering it thereto;

relocatable slurry preparation means, at the slurry preparation location, for utilizing the oil sand delivered thereto, further comminuting it to pumpable size and mixing it with heated water to produce a pumpable, aerated, aqueous oil sand slurry; and

first pipeline means, connected with the slurry preparation means, for receiving the slurry, transporting it while simultaneously conditioning it and delivering it to the desanding location for desanding.

2. The process line as set forth in claim 1 wherein the first conveyor means is a belt conveyor extending along the mine face.

3. A process for producing an oil sand slurry at a mine site having mineable oil sand, a mine face, a slurry preparation location and a desanding location, comprising:

excavating oil sand progressively along the mine face;

comminuting the oil sand to conveyable size;

conveying the comminuted oil sand along the mine face to the slurry preparation location;

mixing the oil sand with heated water at the slurry preparation location and producing a pumpable, aerated, aqueous oil sand slurry; and

transporting the slurry through a pipeline from the slurry preparation location to the desanding location for desanding.

4. A process line for producing desanded product, comprising bitumen and water, and tailings, comprising sand and water, at a mine site having mineable oil sand, a mine face, a slurry preparation location and a desanding location, comprising:

mobile excavating means for advancing along the mine face and excavating oil sand;

mobile sizing means for advancing along behind the excavating means, receiving excavated oil sand and comminuting it to conveyable size;

relocatable first conveyor means for receiving the oil sand from the sizing means, conveying it to the slurry preparation location and delivering it thereto;

relocatable slurry preparation means, at the slurry preparation location, for utilizing the oil sand delivered thereto, further comminuting it to pumpable size and mixing it with heated water to produce a pumpable, aerated, aqueous oil sand slurry containing liquid and sand components;

first pipeline means, connected with the slurry preparation means, for receiving the slurry, transporting it while simultaneously conditioning it and delivering it to the desanding location; and

relocatable desanding means, at the desanding location and connected with the first pipeline means, for receiving the slurry and separating liquid and sand components of the slurry to produce separate streams of desanded product and tailings.

5. The process line as set forth in claim 4 comprising:

a product pipeline, connected with the desanding means, for transporting the desanded product stream from the mine site.

6. The process line as set forth in claim 5 wherein the mine site has a tailings retention facility and comprising:

means, connected with the desanding means, for depositing tailings at the retention facility.

7. The process line as set forth in claim 4, 5 or 6 wherein the desanding means comprises:

a series of countercurrently operating separators for progressively treating slurry to separate bitumen from sand.

8. The process line as set forth in claim 4,5 or 6 wherein:

the first conveyor means extends along the mine face; and

the desanding means comprises a series of countercurrently operating separators for progressively treating slurry to separate bitumen from sand.

9. A process for producing desanded product, comprising bitumen and water, and tailings, comprising sand and water, at a mine site having mineable oil sand, a mine face, a slurry preparation location and a desanding location, comprising:

excavating oil sand progressively along the mine face;

comminuting the oil sand to conveyable size;

conveying the comminuted oil sand along the mine face to the slurry preparation location;

mixing the oil sand with heated water at the slurry preparation location and producing a pumpable, aerated, aqueous oil sand slurry having bitumen and sand components;

transporting the slurry through a pipeline from the slurry preparation location to the desanding location; and

separating bitumen and sand components of the slurry to produce separate desanded product and tailings.

10. The process as set forth in claim 9` wherein:

the mine site has a tailings retention facility, and comprising:

transporting the desanded product from the mine site in a pipeline; and

depositing tailings in the retention facility.

11. The process line of claim 1, 2, 4, 5, 6 or 7 wherein:

the sizing means comprises a first surge bin for receiving and dispensing excavated oil sand, a first double roll crusher for comminuting the dispensed oil sand and means for conveying the dispensed oil sand from the screen means to the crusher.

12. The process line of claim 1, 2, 4, 5, 6, 7 or 11 wherein:

the slurry preparation means comprises a second surge means for receiving and dispensing oil sand from the first conveyor means, a second double roll crusher for comminuting the oil sand, means for conveying oil sand from the second surge means to the second double roll crusher, a jet pump for mixing the oil sand with heated water, a hopper for feeding the oil sand to the jet pump, means for conveying oil sand from the second double roll crusher to the hopper and means for supplying heated water to the jet pump.

13. A process line for producing an oil sand slurry at a mine site having mineable oil sand, a mine face, a slurry preparation location and a desanding location, comprising:

mobile excavating means for advancing along the mine face and excavating oil sand;

mobile sizing means for advancing along behind the excavating means, receiving excavated oil sand and comminuting it to conveyable size;

relocatable first conveyor means for receiving the oil sand from the sizing means, conveying it to the slurry preparation location and delivering it thereto;

relocatable slurry preparation means, at the slurry preparation location, for utilizing the oil sand delivered thereto and mixing it with heated water to produce a pumpable, aerated, aqueous oil sand slurry; and

first pipeline means, connected with the slurry preparation means, for receiving the slurry, transporting it while simultaneously conditioning it and delivering it to the desanding location for desanding;

14. The process line of claim 13 wherein the first conveyor means is a belt conveyor extending along the mine face.

15. The process line of claim 13 or 14 wherein:

the slurry preparation means comprises a rotary digester, means for receiving oil sand from the first conveyor means and feeding it to the rotary digester and means for supplying heated water to the rotary digester.

16. A process line for producing desanded product, comprising bitumen and water, and tailings, comprising sand and water, at a mine site having mineable oil sand, a mine face, a slurry preparation location and a desanding location, comprising:

mobile excavating means for advancing along the mine face and excavating oil sand;

mobile sizing means for advancing along behind the excavating means, receiving excavated oil sand and comminuting it to conveyable size;

relocatable first conveyor means for receiving the oil sand from the sizing means, conveying it to the slurry preparation location and delivering it thereto;

relocatable slurry preparation means, at the slurry preparation location, for utilizing the oil sand delivered thereto and mixing it with heated water to produce a pumpable, aerated, aqueous oil sand slurry;

first pipeline means, connected with the slurry preparation means, for receiving the slurry, transporting it while simultaneously conditioning it and delivering it to the desanding location; and

relocatable desanding means, at the desanding location and connected with the first pipeline means, for receiving the slurry and separating liquid and sand components of the slurry to produce separate streams of desanded product and tailings.

17. The process line of claim 16 wherein the first conveyor means is a belt conveyor extending along the mine face.

18. The process line of claim 16 or 17 wherein:

the slurry preparation means comprises a rotary digester, means for receiving oil sand from the first conveyor means and feeding it to the rotary digester and means for supplying heated water to the rotary digester.

19. The process line as set forth in claim 16, 17 or 18 wherein the desanding means comprises:

a series of countercurrently operating separators for progressively treating slurry to separate bitumen from sand.

20. The process line as set forth in claim 13, 14, 15, 16, 17, 18 or 19 comprising:

a product pipeline, connected with the desanding means, for transporting the desanded product stream from the mine site.

21. The process line as set forth in claim 20 wherein the mine site has a tailings retention facility and comprising:

means, connected with the desanding means, for depositing tailings at the retention facility.

22. The process line as set forth in claim 7, 8 or 19 wherein at least one separator is a cycloseparator.

23. The process line as set forth in claim 7, 8 or 19 wherein at least one separator is an inclined plate settler.

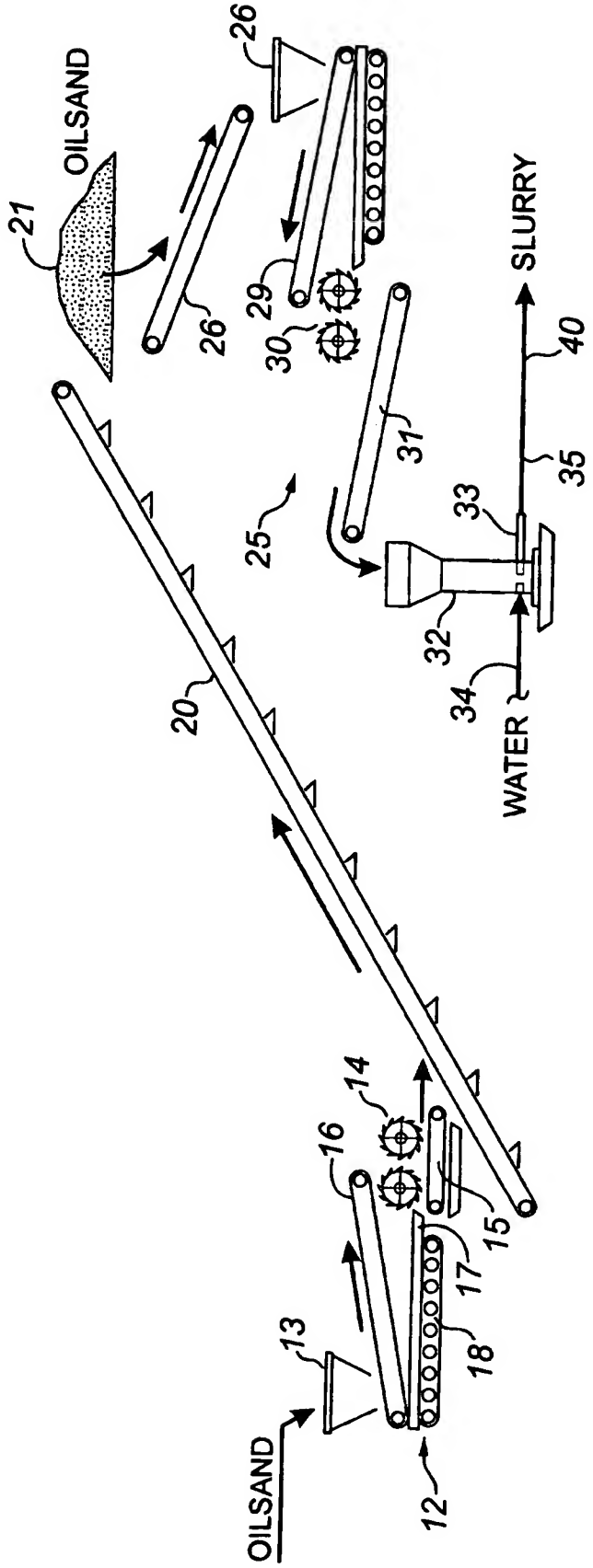
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FIG. 1

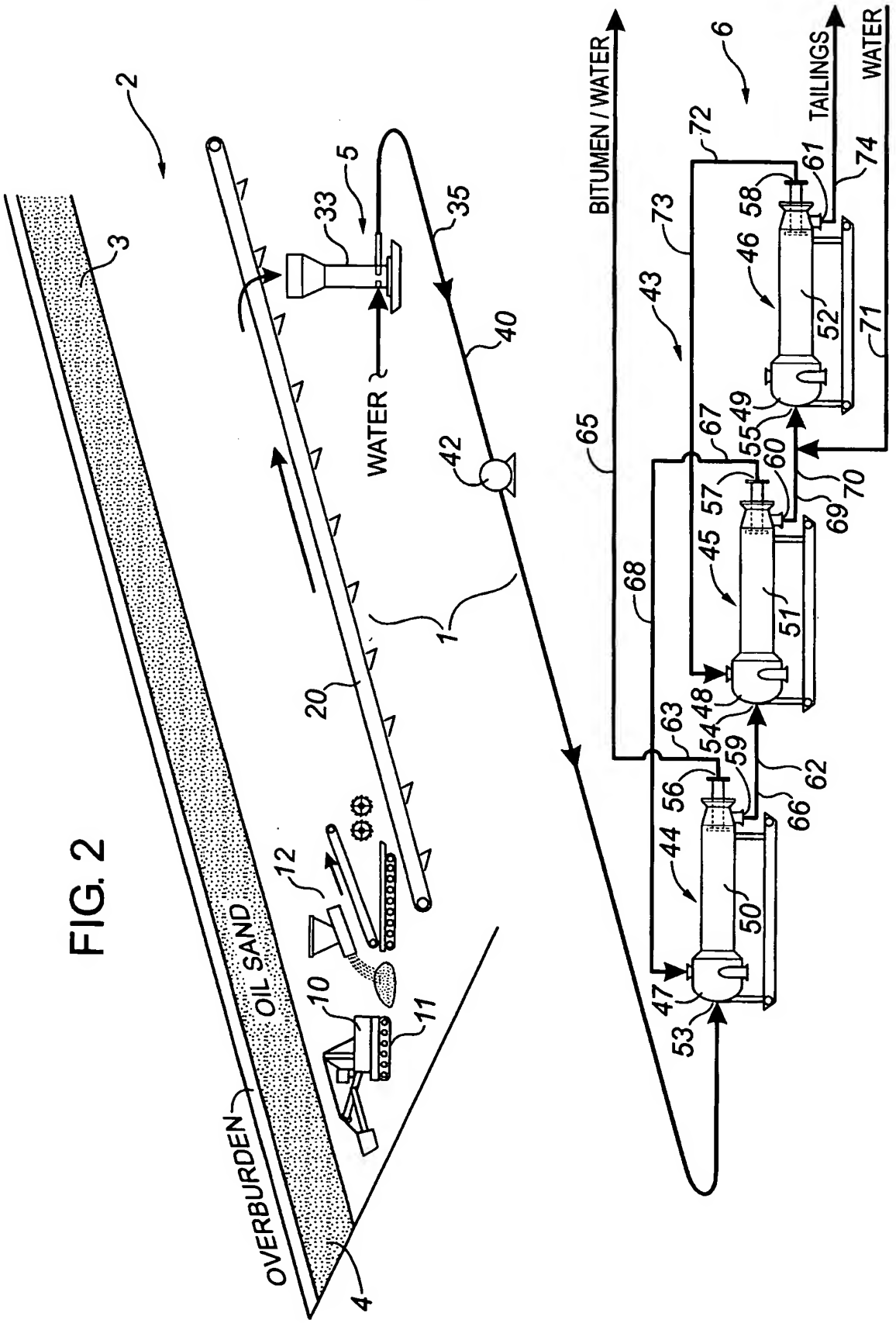
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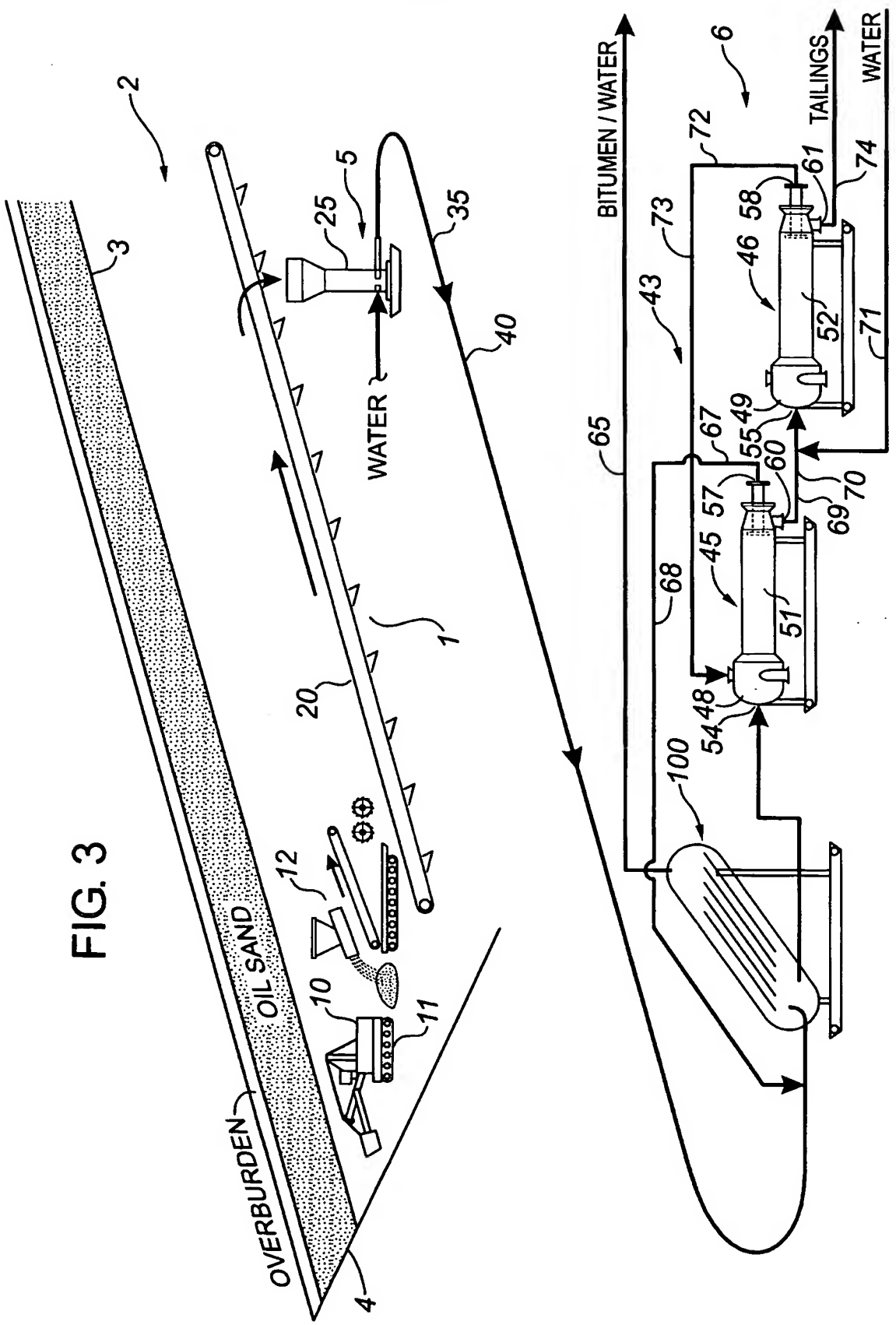
FIG. 2

FIG. 3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BITUMEN / WATER
TAILINGS
WATER
1
2
3
4
5
6
10
11
12
20
25
35
40
43
45
46
48
49
51
52
54
55
57
58
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61
65
67
68
69
70
71
72
73
74
100

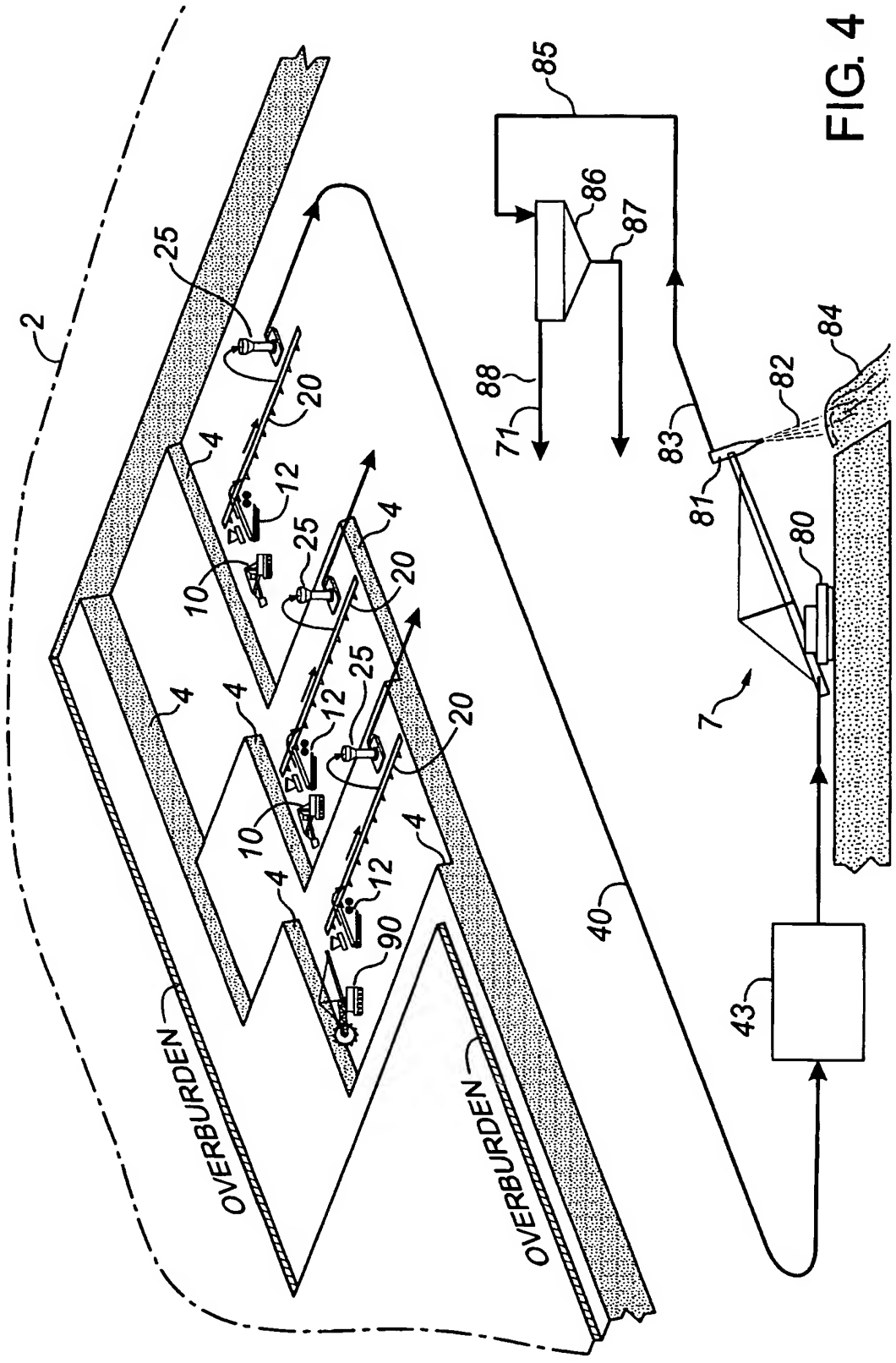

2
25
20
4
12
10
25
20
4
4
12
25
20
4
4
12
10
4
12
90
OVERBURDEN
OVERBURDEN
40
85
86
87
88
71
83
81
82
84
80
7
43

FIG. 4

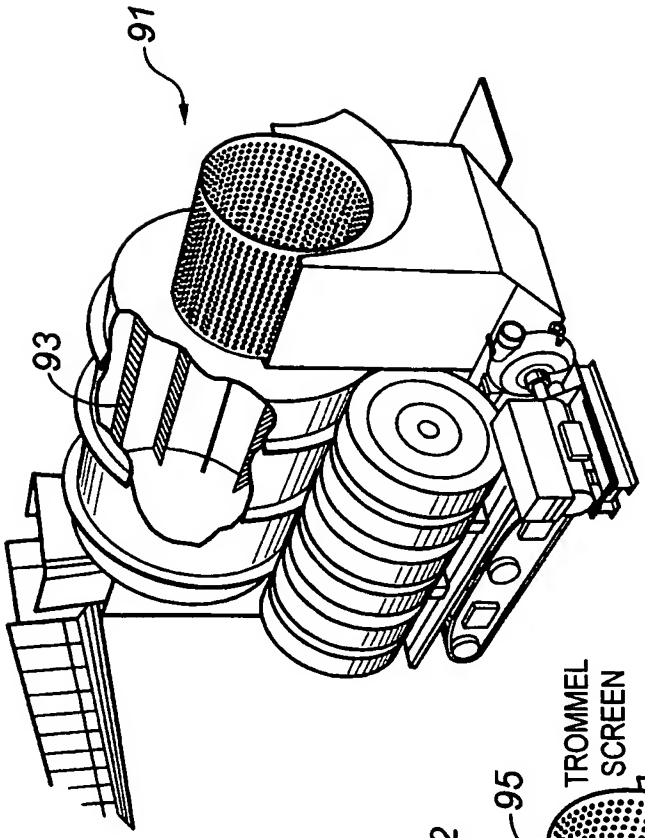

91
93

FIG. 6

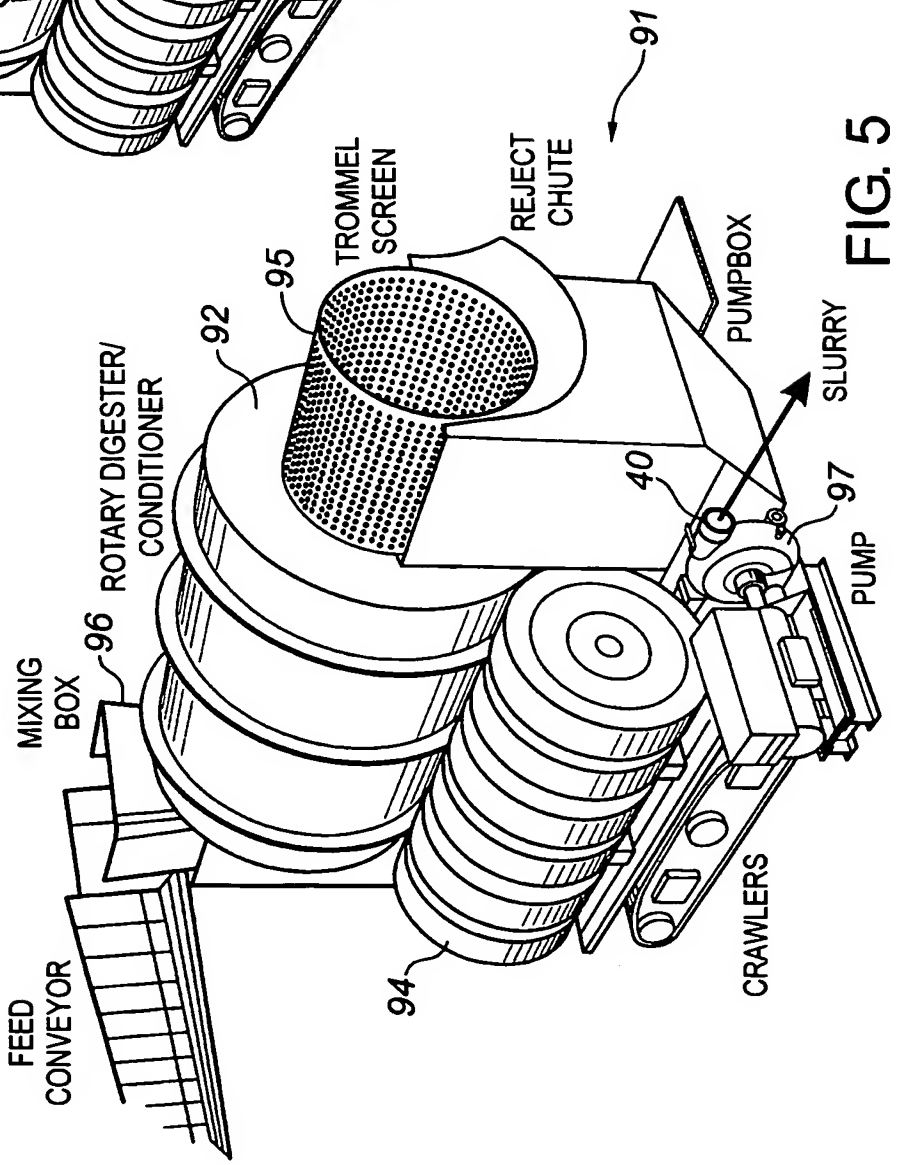

91
TROMMEL SCREEN
REJECT CHUTE
95
92
PUMPBOX
SLURRY
ROTARY DIGESTER/ CONDITIONER
40
97
PUMP
MIXING BOX
96
FEED CONVEYOR
94
CRAWLERS

FIG. 5

FIG. 7

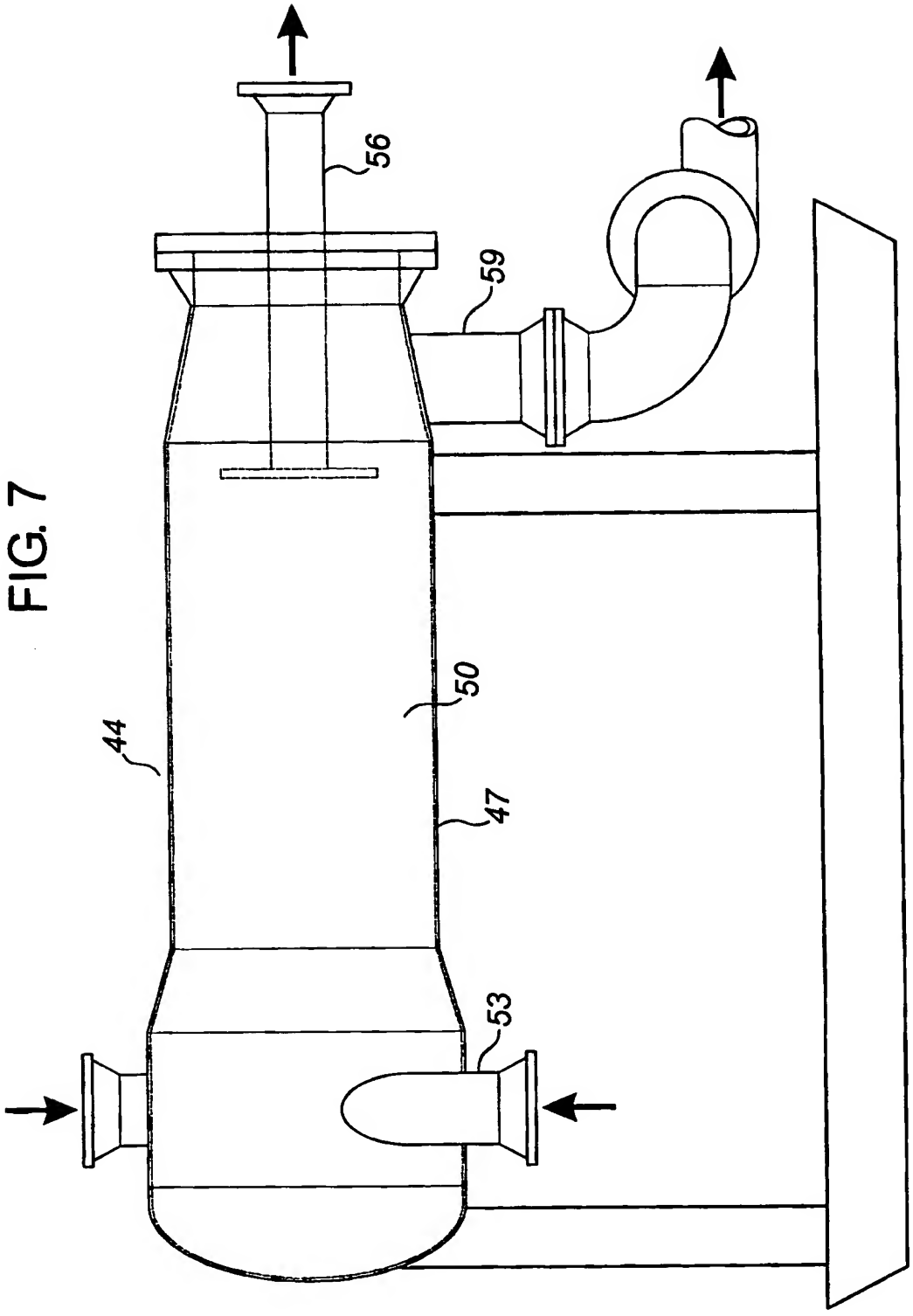
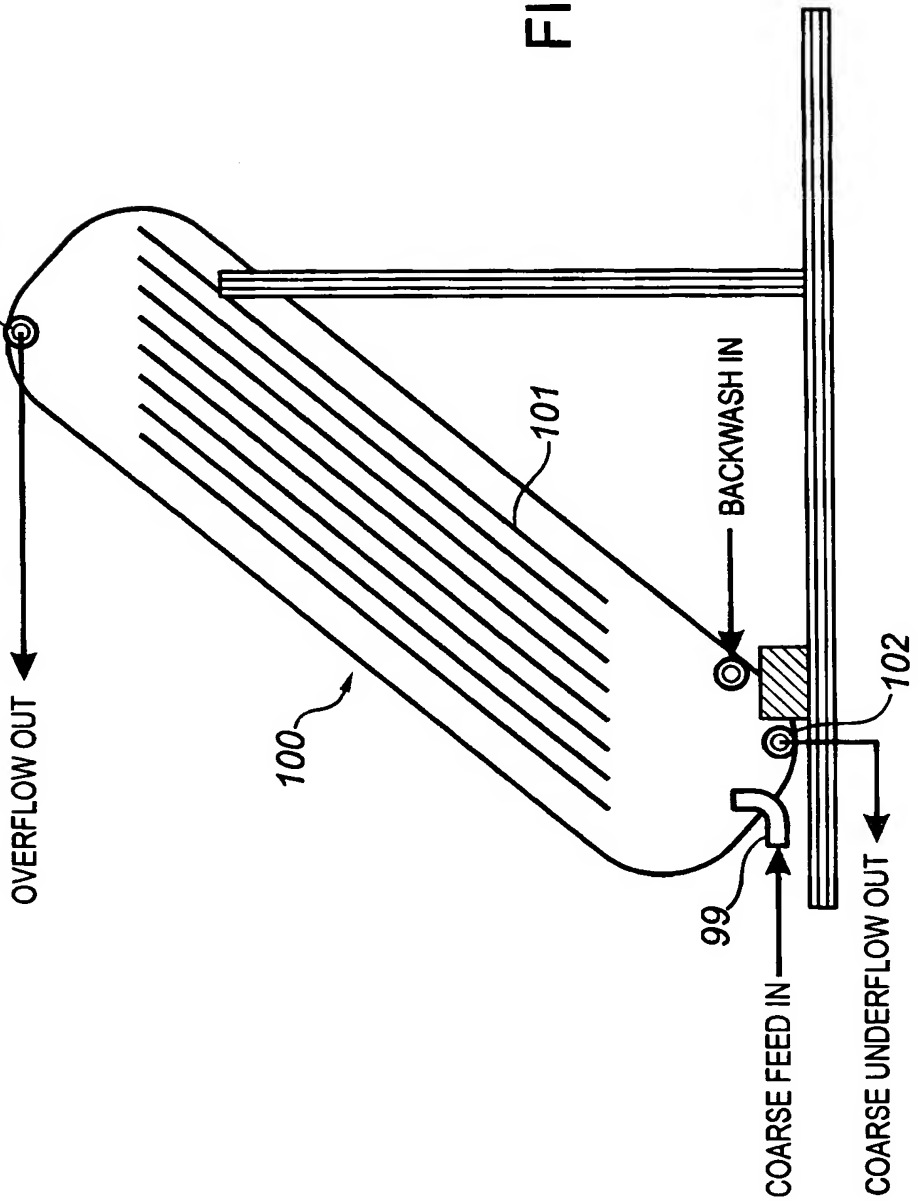


FIG. 8


103
OVERFLOW OUT
100
101
BACKWASH IN
102
99
COARSE FEED IN
COARSE UNDERFLOW OUT